

JAPAN

EDICT OF GOVERNMENT

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JIS Z 9126 (2010) (English): Lighting of outdoor work places

ISO INSIDE

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*The citizens of a nation must
honor the laws of the land.*

Fukuzawa Yukichi

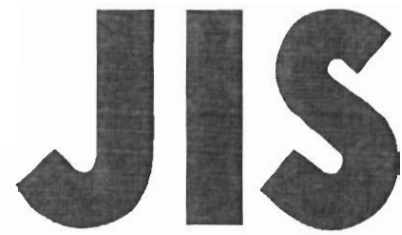
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Lighting of outdoor work places

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by The Illuminating Engineering Institute of Japan (IEIJ)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Lighting of outdoor work places

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **CIE S 015** published in 2005 and the first edition of **ISO/CIE 8995-3** published in 2006 by modifying their technical contents so as to bring them into consistency with **JIS Z 9110**.

The portions with continuous sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with explanations is given in Annex JA.

1 Scope

To enable people to perform visual tasks efficiently and accurately, especially during the night, adequate and appropriate lighting has to be provided. The degree of visibility and comfort required in a wide range of outdoor work places is governed by the type and duration of activity.

This Standard specifies the lighting requirements related to the amount and quality of lighting which will contribute to the visual needs for safety, easiness, efficiency and comfort for performing tasks within outdoor work places or other areas related thereto.

This Standard does not provide explanation on how the lighting systems should be designed to resolve a specific problem, nor does it restrict the freedom of designers to adopt a new technology, or use of new equipment or device.

NOTE 1 For methods of designing the lighting systems and technologies to optimize a specific visual environment, related Guides and Reports of the International Commission on Illumination (Commission Internationale de l'Eclairage, hereafter referred to as **CIE**) and standards issued by the Illuminating Engineering Institute of Japan should be referred to.

NOTE 2 The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows:

CIE S 015:2005 *Lighting of outdoor work places*

ISO/CIE 8995-3:2006 *Lighting of work places—Part 3: Lighting requirements for safety and security of outdoor work places*

(Overall evaluation: MOD)

The symbols which denote the degree of correspondence in the contents in the corresponding International Standard and **JIS** are **IDT** (identical), **MOD** (modified) and **NEQ** (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and any revisions (including

amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent edition (including amendments) shall be applied.

JIS C 7612 Illuminance measurements for lighting installations

JIS Z 8113 Lighting vocabulary

JIS Z 8726 Method of specifying colour rendering properties of light sources

JIS Z 9101 Safety colours and safety signs—Design principles for safety signs in workplaces and public areas

NOTE : Corresponding International Standard: ISO 3864-1 *Graphical symbols—Safety colours and safety signs—Part 1: Design principles for safety signs in workplaces and public areas* (IDT)

JIS Z 9110 General rules of recommended lighting levels

JIS Z 9111 Lighting for roads

NOTE : Corresponding International Standard: CIE 115 *Recommendations for the lighting of roads for motor and pedestrian traffic* (MOD)

CIE 112:1994 *Glare evaluation system for use within outdoor sports and area lighting*

CIE 150:2003 *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in JIS Z 8113 and the following apply.

3.1 visual task

task using vision

NOTE : The principle visual requirements in a visual task are the dimensions and luminance of a visual object, and its contrast against the background and its duration.

3.2 work place

a place provided with work devices or the like where workers perform their tasks, and all the facilities and areas where the workers go in and out during work

3.3 work area

area in a work place where a visual task is performed

When the magnitude and position of a work area are unknown, the work area may be the area in which a task is possible to be performed.

3.4 peripheral area

zone surrounding a work place

NOTE : This zone should have a width of at least 2 m.

3.5 maintained illuminance (\bar{E}_m)

the value below which the average illuminance of a certain plane is not allowed to fall during service period

3.6 overall uniformity of illuminance (U_a)

the ratio of minimum illuminance to the average illuminance of a certain plane

3.7 Outdoor Glare Rating limit (GR_L)

the upper limit value of glare rating value which is based on the discomfort glare rating method specified in **CIE 112** by **CIE** in 1994 (hereafter referred to as *GR* value)

3.8 spill light

light emitted by a lighting installation which falls outside the boundaries of the property on which the installation is sited

3.9 obtrusive light

spill light which, because of the quantitative, directional attributes or light colour and colour rendering properties in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information

3.10 restricted light time zone

time zone in which the service condition of illumination light is restricted by the local government etc. in order to restrict obtrusive light

3.11 upward light output ratio, *ULOR*

ratio of luminaire light output above the horizontal of a luminaire or a device with the luminaire mounted in its normal, designed position to total lamp light output

4 Lighting design standard

4.1 Lighting environment

Lighting design should be based on fulfillment of the basic human desires for the following three conditions and good lighting should be sufficient in both quality and amount:

- a) visual comfort in which workers feel satisfied;
- b) visual workability in which workers can perform visual task under severe conditions for a long duration;
- c) safety.

The main parameters that define the lighting environment are:

- d) luminance distribution;
- e) illuminance;
- f) glare;
- g) light directivity;

- h) light colour and colour rendering properties;
- i) flicker and stroboscopic effect.

Among the above, this Standard shows the design values of quantitative factors such as illuminance, glare and light rendering properties in clause 5.

4.2 Luminance distribution

The luminance distribution within the visual field controls the adaptation level of eyes, and affects the visibility at work. A harmonious luminance distribution is required in order to improve each item shown below:

- a) eyesight (clearness);
- b) contrast sensitivity (discrimination of comparatively small luminance difference);
- c) visual features (focusing, congestion, myosis, eye movement, etc.).

The luminance distribution within the visual field affects visual amenity. Sudden change of luminance should be avoided.

4.3 Illuminance

4.3.1 General

The illuminance and its distribution in a work area and a peripheral area are key parameters that determine how quickly, safely and comfortably perception and a visual task can be performed.

The illuminance specified in this Standard shall be the maintained illuminance, and shall satisfy the requirements for visual amenity, visual workability and safety at the time of the visual task.

4.3.2 Recommended illuminance of work area

The recommended illuminance of work area shall be as specified in clause 5. The recommended illuminance is the average illuminance of a reference surface. The reference surface shall include a horizontal surface, a vertical surface, an inclined surface or a curved surface. The design illuminance for each kind of task or activity shall be determined based on the recommended illuminance given in clause 5. The design illuminance shall be maintained irrespective of the number of elapsed years and the state of lighting facilities.

The recommended illuminance in clause 5 is effective under the normal visual conditions and takes into consideration the factors shown below:

- a) psychological or physiological factors such as visual amenity and comfort;
- b) conditions required for each visual task;
- c) human engineering on vision;
- d) actual experience;
- e) safety;
- f) economic efficiency.

The minimum difference in illuminance recognizable by human sensation is approximately 1.5 times intervals. Illuminance levels shall be as follows:

5–10–15–20–30–50–75–100–150–200–300–500–750–1 000–1 500–2 000 lx

When the visual condition is different from the normal one, the design illuminance may be one stage higher or lower than the illuminance stage from the value of the recommended illuminance given in clause 5.

A higher design illuminance should be set when:

- g) a visual task is precise;
- h) the object of visual task or a worker is moving;
- i) high expenses are required for correcting a mistake;
- j) accuracy or high productivity is very important;
- k) visual performance of a worker is low;
- l) the task object has an extremely small or low contrast;
- m) the duration for a worker to be engaged in a task is extremely long;

A lower design illuminance may be set when:

- n) the task object has an extremely large or high contrast;
- o) a task is performed for an extremely short period of time or fairly infrequently.

4.3.3 Illuminance of peripheral area

The illuminance of a peripheral area should be determined by the design illuminance of a work area, so that the luminance distribution is harmonious within the visual field of a worker.

When there is a large illuminance difference around the work area, visual stress and discomfort may be generated.

Although the illuminance of the peripheral area is normally lower than the illuminance of the work area, the illuminance shall not be less than the value given in table 1.

Table 1 Relation between illuminance of work area and that of peripheral area

Unit: lx

| Maintained illuminance of work area, \bar{E}_m | Illuminance of peripheral area |
|--|--------------------------------|
| ≥ 500 | 100 |
| 300 | 75 |
| 200 | 50 |
| 150 | 30 |
| 50, 75, 100 | 20 |
| <50 | Not specified. |

4.3.4 Measurement point of illuminance

The measurement point of illuminance of a work area and a peripheral area shall be set in order for calculation and verification point of illuminance value to be clear. The method for setting measurement point of illuminance and the measurement method of illuminance shall be as specified in **JIS C 7612**.

4.3.5 Overall uniformity of illuminance

A work area shall be illuminated as uniformly as possible. The overall uniformity of illuminance of the work area shall not be less than the value given in clause 5. The overall uniformity of illuminance of a peripheral area should be 0.10 or more.

4.4 Glare

4.4.1 General

Glare is a sense produced by the high-intensity section within a visual field, and may be experienced as a discomfort glare or a disability glare. The glare produced by reflection from a glossy surface is known as veiling reflection or reflected glare.

Glare is restricted in order to reduce mistakes at work, fatigue and accidents.

When the line of sight is above the horizontal, a special consideration to avoid glare is needed.

4.4.2 Glare rating

Estimation of discomfort glare for outdoor lighting installations shall use the following formula according to the discomfort glare rating method for outdoor lighting facilities specified in **CIE 112**. The *GR* value of a lighting installation should not exceed *GR* limit (*GR_L*) as shown in table 5 to table 18.

$$GR = 27 + 24 \log_{10} \left(\frac{L_{v1}}{L_{ve}^{0.9}} \right)$$

where, L_{v1} : total of equivalent veiling luminance (cd/m^2) of individual luminaires

$$L_{v1} = L_{v1} + L_{v2} + \dots + L_{vn}$$

L_{vn} : veiling luminance (cd/m^2) of each luminaire

$$L_{vn} = 10 \times (E_{eye} / \theta^2)$$

E_{eye} : luminance of surface vertical to the observer's line of sight (2° lower than the horizontal: figure 1) (lx)

θ : angle of the observer's line of sight to each luminaire ($^\circ$)

L_{ve} : ambient equivalent veiling luminance (cd/m^2)

$$L_{ve} = 0.035 \times \rho \times E_{hav} / \pi$$

ρ : average reflection ratio of the area (such as the ground)

E_{hav} : average illuminance of the area (such as the ground) (lx)

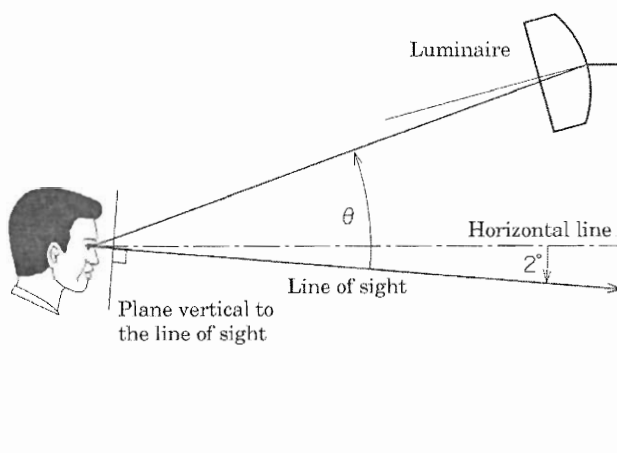


Figure 1 Angle between the observer's line of sight and direction of the light incident from the individual luminaire

The relation between each *GR* stage and the degree of glare shall be as given in table 2.

Table 2 Relation between *GR* stage and degree of glare

| <i>GR</i> stage | Degree of glare |
|-----------------|--------------------|
| 90 | Unbearable |
| 70 | Obstructive |
| 50 | Permissible limit |
| 30 | Barely troublesome |
| 10 | Not troublesome |

4.4.3 Veiling reflection and reflected glare

The high-intensity reflection at the time of a visual task may impair visibility. The veiling reflection and reflected glare can be prevented or reduced by:

- making appropriate a luminaire, a work place and their positional relationship;
- changing the surface finish (for example, delustering);
- regulating the luminance of a luminaire;
- increasing the area of the light emitting part of a luminaire.

4.5 Obtrusive light

Obtrusive light shall be restricted in order to conserve the night environment. In many cases, obtrusive light is caused by the spill light from lighting facilities, and poses physiological and ecological problems for the surrounding environment and people.

For minimizing the problems for people, plants and animals, the maximum permissible value of the obtrusive light from outdoor lighting facilities specified in **CIE 150** is given in table 3.

Table 3 Maximum value at which obtrusive light from outdoor lighting facilities is permitted

| Environmental zone | Illuminance to ground ^{a)} | | Luminous intensity of luminaire | | Upward light output ratio | Luminance | | |
|--------------------|---|----------------------------------|-----------------------------------|----------------------------------|---------------------------|-----------|----------------------------|----------------------------|
| | E_v (lx) | | I ($\times 1\ 000$ cd) | | | $ULOR$ | L_b (cd/m ²) | L_s (cd/m ²) |
| | Before restricted light time zone ^{b)} | After restricted light time zone | Before restricted light time zone | After restricted light time zone | | | Building side | Sign side |
| E1 | 2 | 0 ^{c)} | 2.5 | 0 | 0 | 0 | 50 | |
| E2 | 5 | 1 | 7.5 | 0.5 | 0.05 | 5 | 400 | |
| E3 | 10 | 2 | 10 | 1.0 | 0.15 | 10 | 800 | |
| E4 | 25 | 5 | 25 | 2.5 | 0.20 | 25 | 1 000 | |

where, E1: Natural environment, an originally dark light environment such as national parks and protected locations

E2: Countryside, a light environment of low brightness such as industrial or residential country areas

E3: Suburbs, a light environment of medium degree of brightness such as industrial or residential suburbs areas

E4: City, a light environment of high brightness such as central urban areas and commercial areas

E_v : Upper limit of vertical illuminance of ground (lx)

I : Luminous intensity of each luminaire to the direction in which it is considered to produce an obstacle ($\times 1\ 000$ cd)

$ULOR$: Ratio of luminaire light output above the horizontal of a luminaire or a device with the luminaire mounted in its normal, designed position to the total lamp light output

L_b : Upper limit of average luminance of building side (cd/m²)

L_s : Upper limit of average luminance of sign side (cd/m²)

Notes ^{a)} It is applied to the windows of neighbouring houses, the side related in the case where houses will be built in future, etc.

^{b)} When the restricted light time zone is not applicable, the values for “after restricted light time zone” should be applied.

^{c)} When a luminaire is used for a public lighting (road etc.), this value shall be 1 lx.

4.6 Light directivity

4.6.1 General

Light having directivity is used for making an object conspicuous, expressing a texture and improving how people see. This is expressed by the word "modeling", and lighting having directivity may improve the visibility in a visual task.

4.6.2 Modeling

Modeling should be considered in lighting people and objects so that they look clear and desirable. Modeling is related to the balance between light diffusibility and light directivity, and the shadow that serves as a foundation of good modeling is made when

light enters from single direction. However, the lighting shall not have such a strong directivity as producing an uncomfortable shadow.

4.6.3 Directional lighting in visual task

In order to make the details in a visual task clear, improve visibility and make it easier to perform the task, the lighting from a specific direction shall be used. However, veiling reflection and reflected glare should be avoided.

4.7 Light colour and colour rendering properties

4.7.1 General

The colour characteristics of a near-white lamp are characterized by the following two characteristics, and these shall be considered separately:

- a) light colour of a lamp itself;
- b) how the colour of the object lighted by a lamp looks (colour rendering).

4.7.2 Light colour

The light colour of a lamp is related to the apparent colour of the light emitted by the lamp (chromaticity), and expressed by correlated colour temperature (T_{CP}). The feature of the light colour is given in table 4.

Selection of light colour is concerned with psychological state and aesthetic sense, and should therefore be made aiming for natural appearance.

NOTE: When a lamp of cool light colour is used for lighting an area with low illuminance, the resultant appearance of colours may give a chilling feeling.

Table 4 Light colour classification of lamp

| Light colour | Correlated colour temperature (T_{CP}) |
|----------------|--|
| Warm colour | Less than 3 300 K |
| Neutral colour | 3 300 K to 5 300 K |
| Cool colour | Over 5 300 K |

4.7.3 Colour rendering properties

It is important for visual performance and the feeling of comfort and well being, that colours in the environment, of objects and of human skin are rendered naturally.

To provide an objective indication of the colour rendering properties of a light source the general colour rendering index (hereafter referred to as R_a) as defined in **JIS Z 8726**, has been introduced. The maximum value of R_a is 100. This figure decreases with decreasing colour rendering quality. The recommended minimum values of R_a are shown in table 5 to table 18.

Safety colours as described in **JIS Z 9101** shall always be recognizable and clearly distinguishable.

4.8 Flicker and stroboscopic effect

A flicker can cause a person to be distracted and induce physiological effects like headaches. A stroboscopic effect can cause a risk of danger by making the rotation or reciprocation of a machine appear as if changing. Lighting systems should be designed with consideration to avoid flicker and stroboscopic effect.

NOTE : As a countermeasure, a technical action suitable for the selected lamp shall be taken (for example, a discharge lamp is lighted using the high-frequency ballast.).

4.9 Maintenance factor

The recommended illuminance is an illuminance to maintain in expectation of a maintenance factor. The maintenance factor shall be determined based on the selected light source, the selected luminaire, and the environment and specific maintenance plan.

The designer should not only clarify the conditions from which the maintenance factor has been derived, but also present the comprehensive maintenance plan including the replacement frequency of a lamp, the cleaning frequency of a luminaire, the cleaning method, etc.

NOTE : For the calculation method of the maintenance factor, Technical Guideline **JIEG-001** published by the Illuminating Engineering Institute of Japan is available.

4.10 Consideration of energy

The lighting facilities should satisfy the lighting requirements for a work area or activity area without wasting energy. However, it is important that visual aspect of lighting facilities should not be compromised as a result of reduction of energy consumption. Therefore, a suitable light source, lighting circuit, luminaire, control and use of daylight should be considered.

4.11 Environmental sustainability

Lighting facilities should be designed with consideration not to destroy the environment. Therefore, luminaire suitable for the purpose of use shall be selected.

4.12 Emergency lighting

Emergency lighting shall be prepared in accordance with related laws and regulations so that it operates when the normal power supply to a lighting system is cut off.

5 List of lighting requirements

5.1 General

The lighting requirements concerning the safety of a worker at work shall be as given in table 5. Furthermore, the lighting requirements concerning the specific work place shall be as given in table 6 to table 18.

In addition, the parking lot and station building (related to a railway) related to an outdoor work place shall be in accordance with **JIS Z 9110**.

The method of indication in table 5 to table 18 shall be as follows:

- a) **Column 1 List of area, task or activity** Column 1 shows the risk level of a worker at work or examples of area, task or activity. Where a particular area, task or activity is not described, the value for a situation similar to this or situation considered to be equivalent to this shall be adopted.
- b) **Column 2 Maintained illuminance [\bar{E}_m , lux (lx)]** Column 2 gives the recommended values of \bar{E}_m on the reference surface corresponding to those given in column 1.
- NOTE : Lighting control may be required to achieve adequate flexibility for the variety of tasks performed.
- c) **Column 3 Overall uniformity of illuminance (U_o)** Column 3 gives the minimum U_o on the reference surface corresponding to those given in column 1.
- d) **Column 4 Outdoor Glare Rating limit (GR_L)** Column 4 gives the GR_L where these are applicable to the situations listed in column 1.
- e) **Column 5 General colour rendering index (R_a)** Column 5 gives the minimum R_a for the situation given in column 1.
- f) **Column 6 NOTE** Exceptions and special application of the situations given in column 1 shall be described in NOTE.

Table 5 Lighting requirements concerning safety of worker at work

| Risk level of a worker at work | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|---|------------------|-------|--------|-------|--|
| Very low risks, e.g.: <ul style="list-style-type: none"> — storage areas with occasional traffic in industrial yards; — coal fields in power plants; — timber storage, sawdust and wood chip fields in saw mills; — occasionally used service passages and stairs, waste water cleaning and aeration tanks, filter and sludge digestion tanks in water and sewage plants. | 5 | 0.25 | 55 | 20 | |
| Low risks, i.e.: <ul style="list-style-type: none"> — general lighting in harbours; — areas of risk free process and occasionally used platforms and stairs in petrochemical and other hazardous industries; — sawn timber storage areas in saw mills. | 10 | 0.40 | 50 | 20 | In harbours, U_o may be 0.25. |
| Medium risks, i.e.: <ul style="list-style-type: none"> — vehicle storage areas and container terminals with frequent traffic in harbours, industrial yards and storage areas; — vehicle storage areas and conveyors in petrochemical and other hazardous industries; — oil stores in power plants; — general lighting and storage areas for prefabricated goods in shipyards and docks; — regularly used stairs, basins and filters of clean water plants in water and sewage plants. | 20 | 0.40 | 50 | 20 | In shipyards and docks, U_o may be 0.25. |

Table 5 (concluded)

| Risk level of a worker at work | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|--|------------------|-------|--------|-------|---|
| High risks, i.e.: — Element mould, timber and steel storage, building foundation hole and working areas on sides of the hole at building sites — Fire, explosion, poison and radiation risk areas in harbours, industrial yards and storage areas — Oil stores, cooling towers, boilers compressors, pumping plants, valves, manifolds, operating platforms, regularly used stairs, crossing points of conveyors, electric switch-yards in petrochemical and other hazardous industries — Switch yards in power plants — Crossing points of conveyors, fire risk areas in saw mills | 50 | 0.40 | 45 | 20 | At building sites and in saw mills, GR_L may be 50. |

5.2 General passing areas of outdoor work places

Table 6 General passing areas of outdoor work places

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|---|------------------|-------|--------|-------|---|
| Pedestrian roads | 5 | 0.25 | 50 | 20 | — |
| Low-speed traffic (maximum 10 km/h) Example: bicycles, trucks, excavators. | 10 | 0.40 | 50 | 20 | — |
| Normal vehicular traffic (maximum 40 km/h) | 20 | 0.40 | 45 | 20 | At ship building yards and docks, GR_L may be 50. |
| Pedestrian corridors, turnarounds of vehicles and areas of disposal of goods. | 50 | 0.40 | 50 | 20 | — |
| For road traffic, see JIS Z 9111 . | | | | | |

5.3 Airports

Table 7 Airports

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|--|------------------|-------|--------|-------|---|
| Aprons in front of hangar | 20 | 0.10 | 55 | 20 | — |
| Aprons for boarding and alighting of passengers | 30 | 0.20 | 50 | 40 | — |
| Areas of disposal of goods | 30 | 0.20 | 50 | 40 | For reading of labels, \bar{E}_m 50 lx. |
| Fuel storage areas | 50 | 0.20 | 50 | 40 | — |
| Airplane maintenance stands | 200 | 0.50 | 45 | 60 | — |
| — When the airport is operated in accordance with the requirements of ICAO (International Civil Aviation Organization), their recommended value shall be applied. — The direct light to the direction of an airport traffic control tower and a landing airplane shall be avoided. — The light directly irradiated upward among lights emitted from a floodlight shall be restricted to the minimum. | | | | | |

5.4 Construction areas

Table 8 Construction areas

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|--|------------------|-------|--------|-------|------|
| Ground leveling, digging and accumulation of earth | 20 | 0.25 | 55 | 20 | — |
| Construction sites, and mounting of waste pipes, conveyance, auxiliary work and storing work. | 50 | 0.40 | 50 | 20 | — |
| Installation of frame members, easy arrangement of bars, wooden frame formation and frame mounting, and electric piping and wiring | 100 | 0.40 | 45 | 40 | — |
| Junction of members, supply of electric power, and installation of machinery and pipes | 200 | 0.50 | 45 | 40 | — |

5.5 Canals, water gates and ports

Table 9 Canals, water gates and ports

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|--|------------------|-------|--------|-------|--|
| Waiting wharfs of canals and water gates | 10 | 0.25 | 50 | 20 | — |
| Holding wharfs of canals and water gate | 10 | 0.25 | 50 | 20 | — |
| Water gate control sections and bottom cargo sites | 20 | 0.25 | 55 | 20 | — |
| Cargo handling, carrying in, and loading and unloading | 30 | 0.25 | 55 | 20 | For reading of labels, \bar{E}_m 50 lx. |
| Passenger areas of passenger wharfs | 50 | 0.40 | 50 | 20 | — |
| Connecting work of hoses, pipes and ropes | 50 | 0.40 | 50 | 20 | — |
| Hazardous areas of walkways and roadways | 50 | 0.40 | 45 | 20 | — |

5.6 Farms

Table 10 Farms

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|---------------------------------|------------------|-------|--------|-------|------|
| Farm yards | 20 | 0.10 | 55 | 20 | — |
| Equipment warehouses (outdoors) | 50 | 0.20 | 55 | 20 | — |
| Enclosures of animal sorting | 50 | 0.20 | 50 | 40 | — |

5.7 Fuel service stations

Table 11 Fuel service stations

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_s | NOTE |
|--|------------------|-------|--------|-------|------|
| Parking and storage areas of vehicles | 5 | 0.25 | 50 | 20 | — |
| Roads for vehicles of entrance: dark environment (rural zones and suburbs) | 20 | 0.40 | 45 | 20 | — |
| Roads for vehicles of entrance: bright environment (urban areas) | 50 | 0.40 | 45 | 20 | — |
| Inspection sites of atmospheric pressure and water, and other work places | 150 | 0.40 | 45 | 20 | — |
| Meter reading areas | 150 | 0.40 | 45 | 20 | — |

5.8 Industrial sites and warehouses

Table 12 Industrial sites and warehouses

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_s | NOTE |
|---|------------------|-------|--------|-------|------|
| Temporary handling of large-sized devices and raw materials, and loading and unloading of large-capacity goods | 20 | 0.25 | 55 | 20 | — |
| Continuous handling of large-sized devices and raw materials, loading and unloading of shipping freights, up and down work sites for cranes, and outdoor platforms for cargos | 50 | 0.40 | 50 | 20 | — |
| Reading of addresses, platforms for covered cargos, use of tools, and normal reinforcement and moulding work at concrete plants | 100 | 0.50 | 45 | 20 | — |
| Construction and inspection of electric equipment, machinery and piping equipment that need high technology | 200 | 0.50 | 45 | 60 | — |

5.9 Marine gas and oil-field facilities

Table 13 Marine gas and oil-field facilities

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|--|------------------|-------|--------|-------|---|
| Sea surface under rigs | 30 | 0.25 | 50 | 20 | — |
| Ladders, stairs and pedestrian ways | 100 | 0.25 | 45 | 20 | For ladders, stairs, on footboards. |
| Arrival and departure areas for boats and transportation areas | 100 | 0.25 | 50 | 20 | — |
| Helideck | 100 | 0.40 | 45 | 20 | 1 The direct light to the direction of an airport traffic control tower and a landing airplane shall be avoided. 2 The light directly irradiated upward among lights emitted from a floodlight shall be restricted to the minimum. |
| Watch-towers | 100 | 0.50 | 45 | 40 | — |
| Refining areas | 100 | 0.50 | 45 | 40 | — |
| Pipe rack areas and decks | 150 | 0.50 | 45 | 40 | — |
| Laboratories, shale shakers and wellheads | 200 | 0.50 | 45 | 40 | — |
| Pumping areas | 200 | 0.50 | 45 | 20 | — |
| Life boat areas | 200 | 0.40 | 50 | 20 | — |
| Digging floors and monkey boards | 300 | 0.50 | 40 | 40 | Special precautions for string intercalation are needed. |
| Mud rooms and sampling | 300 | 0.50 | 40 | 40 | — |
| Crude oil pumps | 300 | 0.50 | 45 | 40 | — |
| Plant areas | 300 | 0.50 | 40 | 40 | — |
| Rotary tables | 500 | 0.50 | 40 | 40 | — |

5.10 Petrochemistry and other hazardous industries

Table 14 Petrochemistry and other hazardous industries

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|---|------------------|-------|--------|-------|--|
| Hand work using tools, adjustment of valves by hand work, start and stop of motors, and lighting burners. | 20 | 0.25 | 55 | 20 | — |
| Filling or extracting non-hazardous substances into or from the container trucks or the wagons, and inspection of leak of piping and packing | 50 | 0.40 | 50 | 20 | — |
| Filling or extracting hazardous substances into or from the container trucks or the wagons, refilling by pumps, general work, and reading of meters | 100 | 0.40 | 45 | 40 | — |
| Sites where fuel is filled or extracted | 100 | 0.40 | 45 | 20 | — |
| Repair of machinery or electric devices | 200 | 0.50 | 45 | 60 | It is desirable to use local lighting. |

5.11 Electric power plants, gas plants and thermal plants

Table 15 Electric power plants, gas plants and thermal plants

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_s | NOTE |
|---|------------------|-------|--------|-------|--|
| Movement in pedestrian corridors of areas which are electrically safe | 5 | 0.25 | 50 | 20 | — |
| Handling of mechanical equipment and materials and coal | 20 | 0.25 | 55 | 20 | — |
| Walk-around inspection | 50 | 0.40 | 50 | 20 | — |
| General replenishing work and reading of meters | 100 | 0.40 | 45 | 40 | — |
| Tunnel ventilation: replenishment and maintenance | 100 | 0.40 | 45 | 40 | — |
| Repair of electric appliances | 200 | 0.50 | 45 | 60 | It is desirable to use local lighting. |

5.12 Sawmills

Table 16 Sawmills

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_s | NOTE |
|---|------------------|-------|--------|-------|------|
| Handling of logs and sawdust, and conveyors for wood chips in land and water | 20 | 0.25 | 55 | 20 | — |
| Sorting of logs, loading and unloading of logs, loading of lumbers, loading and stacking to conveyors for logs by lifts | 50 | 0.40 | 50 | 20 | — |
| Reading of addresses and markings on the side of logs that are sawed | 100 | 0.40 | 45 | 40 | — |
| Sorting and packing | 200 | 0.50 | 45 | 40 | — |
| Insertion into bark peeling machines and delimbing machines | 300 | 0.50 | 45 | 40 | — |

5.13 Shipbuilding yards and docks

Table 17 Shipbuilding yards and docks

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_s | NOTE |
|---|------------------|-------|--------|-------|------|
| General lighting of shipbuilding yards and storage sites of parts | 20 | 0.25 | 55 | 40 | — |
| Rough handwork for a short period of time | 20 | 0.25 | 55 | 20 | — |
| Hull cleaning | 50 | 0.25 | 50 | 20 | — |
| Paint application or welding of hulls | 100 | 0.40 | 45 | 60 | — |
| Mounting of mechanical or electric devices | 200 | 0.50 | 45 | 60 | — |

5.14 Water and sewage

Table 18 Water and sewage

| Type of area, task or activity | \bar{E}_m (lx) | U_o | GR_L | R_a | NOTE |
|--|------------------|-------|--------|-------|------|
| Handling of tools, valve operations, start and stop of motors, piping packing, and cleaning of machines | 50 | 0.40 | 45 | 20 | — |
| Handling of chemicals, leakage inspection, exchange of pumps, general supply work and reading work of meters | 100 | 0.40 | 45 | 40 | — |
| Repair of electric parts or motors | 200 | 0.50 | 45 | 60 | — |

6 Verification procedures

Verification of lighting installation shall be by measurement, calculation or inspection of data.

6.1 Illuminance

Verification shall be by checking the average illuminance and overall uniformity of illuminance against the values in table 5 to table 18 to see if they satisfy the requirements. The illuminance shall be measured at the specified points in the reference plane corresponding to the task or activity according to **JIS C 7612**. For repetitive measurements, the same measurement points shall be used.

6.2 Outdoor Glare Rating limit (GR_L)

Verification shall be by checking the GR values against the GR_L values in table 5 to table 18 to see if they satisfy the requirements. Further, in calculation of GR value, it shall be confirmed that the lighting facility and its location, the surface finish of the space and the area are in accordance with the given conditions of calculation. The GR value and its calculation conditions shall be provided by the designer.

6.3 Obtrusive light

As required, it shall be checked that E_v , I , $ULOR$, L_b and L_s do not exceed the values specified in table 3. These values shall be provided by the designer.

6.4 General colour rendering index (R_a)

Verification shall be by checking if R_a value satisfies the lighting design condition. The lamp shall be selected at the design stage. R_a of the lamp used in design shall be provided by the lamp manufacturer.

Bibliography:

Technical Guidelines published by the Illuminating Engineering Institute of Japan
 JIEG-001 *Maintenance factor of lighting design and maintenance plan*
 JIEG-004 *Criteria for emergency lighting*

Annex JA (informative)

Comparison table between JIS and corresponding International Standards

| JIS Z 9126:2010 <i>Lighting of outdoor work places</i> | | | | CIE S 015:2005 <i>Lighting of outdoor work places</i> ISO/CIE 8995-3:2006 <i>Lighting of work places—Part 3: Lighting requirements for safety and security of outdoor work places</i> | | | |
|--|--|------------------------------------|--|--|---|--|---|
| (I) Requirements in JIS | | (II) International Standard number | (III) Requirements in International Standard | | (IV) Classification and details of technical deviation between JIS and the International Standard by clause | | (V) Justification for the technical deviation and future measures |
| No. and title of clause | Content | | Clause No. | Content | Classification by clause | Detail of technical deviation | |
| 1 Scope | Lighting requirements in outdoor work places | CIE S 015 | 1 | Approximately identical with JIS. | Alteration | Scope in CIE is modified to include safety and security matters. | The scopes in the two standards are modified to include all the lighting requirements in outdoor work places. As a result of this, this JIS is in conformity with two International Standards. |
| | | ISO/CIE 8995-3 | 1 | Approximately identical with JIS. | Alteration | The description in ISO/CIE by which the scope is limited to safety and security matters is deleted, and the scope is modified to include all the lighting requirements in outdoor work places. | |
| 2 Normative references | | | | | | | |
| 3 Terms and definitions | Terms and definitions | CIE S 015 | 3 | Approximately identical with JIS. | Deletion | Minimum and maximum illuminance ratio (3.2 of CIE S 015) | The term is deleted because of another modification in which “railway and street car” shall be in accordance with JIS Z 9110, which makes definition of this term in this Standard unnecessary. This does not constitute any technical deviation. |

| (I) Requirements in JIS | | (II) International Standard number | (III) Requirements in International Standard | | (IV) Classification and details of technical deviation between JIS and the International Standard by clause | | (V) Justification for the technical deviation and future measures |
|--------------------------------|--|---|--|---|--|---|--|
| No. and title of clause | Content | | Clause No. | Content | Classification by clause | Detail of technical deviation | |
| 3 Terms and definitions | Terms and definitions | CIE S 015 ISO/CIE 8995-3 | 3 | Approximately identical with JIS . | Alteration | <i>ULR</i> (3.10 of CIE S 015) is altered to <i>ULOR</i> . | It is necessary to raise the utility factor by specifying <i>ULOR</i> (upward light output/lamp light output) in order to achieve energy saving in a certain area while restricting obtrusive light. At present this proposal is being presented to ISO toward the revision of ISO standard. This term is deleted since 3.2 work place and 3.3 work area are already defined, and it is not necessary to further define 3.13 work station separately from them. This does not constitute any technical deviation. Terms concerning all the light requirements in outdoor work places are added because one JIS is created from two International Standards. This does not constitute any technical deviation. |
| | | | | | Deletion | Workstation (3.13 of CIE S 015) is deleted. | |
| | | | | | Addition | Visual task, work place, work area, peripheral area, spill light, obtrusive light, restricted light time zone and upward light output ratio are added. | |
| 4 Lighting design standard | 4.3.4 Measurement point of illuminance | CIE S 015 | 4.3.3 | Approximately identical with JIS . | Alteration | The method to determine measurement point by the formula is deleted and replaced with the description that the method "shall be in accordance with JIS C 7612 ". | JIS C 7612 is treated as a normative reference because it is often difficult to apply the formula. This does not constitute any technical deviation. |

| (I) Requirements in JIS | | (II) International Standard number | (III) Requirements in International Standard | | (IV) Classification and details of technical deviation between JIS and the International Standard by clause | | (V) Justification for the technical deviation and future measures |
|--------------------------------|---|------------------------------------|--|---|--|---|--|
| No. and title of clause | Content | | Clause No. | Content | Classification by clause | Detail of technical deviation | |
| 4 Lighting design standard | 4.3.5 Overall uniformity of illuminance | CIE S 015 | 4.3.4 | Approximately identical with JIS . | Alteration | The description is altered from "shall not be less than 0.10" to "should be 0.10 or more". | Altered based on the judgment that the requirement is too severe for a recommended standard. This does not constitute any technical deviation. |
| | 4.4.2 Glare rating | CIE S 015 | 4.4.1 | Approximately identical with JIS . | Alteration | The description is altered from "shall not exceed GR_1 given in table 5 to table 18" to "should not exceed". | The GR value, derived either by desk calculation or by measurement of equivalent veiling luminance using a special measuring instrument, is not of such a high accuracy as suitable for severity of "shall not exceed" requirement. This does not constitute any technical deviation. |
| | 4.5 Obtrusive light | CIE S 015 | 4.5 | Approximately identical with JIS . | Addition | The relation between GR stage and degree of glare is additionally presented in a table. | The table is added as an aid for clear understanding of the relation between GR stage and degree of glare. This does not constitute any technical deviation. |
| | | | | | Alteration | In the specification of upward light output ratio, ULR is altered to $ULOR$ which is in conformity with the Guideline of Measures against Light Pollution established by the Ministry of the Environment. Furthermore, for E4, the value 0.25 is altered to 0.20. | Altered because it is necessary to raise utilization factor by specifying $ULOR$ (upward light output/ lamp light output) in order to achieve energy saving in a certain area while restricting obtrusive light. At present this proposal is being presented to ISO toward the revision of ISO standard. |
| | | | | | Deletion | The maximum value of threshold increase in table 3 is deleted. | The value is deleted because it is not specified in JIS Z 9111 (Lighting for roads). |

| (I) Requirements in JIS | | (II) International Standard number | (III) Requirements in International Standard | | (IV) Classification and details of technical deviation between JIS and the International Standard by clause | | (V) Justification for the technical deviation and future measures |
|---------------------------------|--|------------------------------------|--|---|--|--|--|
| No. and title of clause | Content | | Clause No. | Content | Classification by clause | Detail of technical deviation | |
| 4 Lighting design standard | 4.7.3 Colour rendering properties | CIE S 015 | 4.7 | Approximately identical with JIS . | Deletion | With regard to the recognition and distinction of safety colour, the description "general colour rendering index (R_a) ≥ 20 " is deleted. | The description is deleted because it is practically unlikely that light source with R_a lower than 20 is used. This does not constitute any technical deviation. |
| | Lighting design standard | ISO/CIE 8995-3 | | No relevant clause. | Addition | Clause 4 is added. | This addition is due to merging two International Standards into one JIS . This does not constitute any technical deviation. |
| 5 List of lighting requirements | 5.1 General | CIE S 015 | 5 | Approximately identical with JIS . | Addition | Lighting requirements concerning the safety of a worker at work are added as 5.1 . | This addition is due to merging two International Standards into one JIS . This does not constitute any technical deviation. |
| | | | | | Alteration | Replaced with the description "the parking lot and station building (related to a railway) related to an outdoor work place shall be in accordance with JIS Z 9110 ". | This alteration is for avoiding the presence of double standards, since the relevant specification is already given in JIS Z 9110 . This does not constitute any technical deviation. |
| | Lighting requirements of specific area, task or activity | ISO/CIE 8995-3 | | No relevant clause. | Addition | 5.2 to 5.14 are added. | This addition is due to merging two International Standards into one JIS . This does not constitute any technical deviation. |
| 6 Verification procedures | 6.1 Illuminance | CIE S 015 | 6.1 | Approximately identical with JIS . | Alteration | Altered from the method to determine measurement point by the formula to the method by JIS C 7612 . | There is no technical deviation. |
| | | ISO/CIE 8995-3 | 5.1 | Approximately identical with JIS . | Alteration | | |

| (I) Requirements in JIS | | (II) International Standard number | (III) Requirements in International Standard | | (IV) Classification and details of technical deviation between JIS and the International Standard by clause | | (V) Justification for the technical deviation and future measures |
|--------------------------------|------------------------------------|------------------------------------|--|---|--|--|---|
| No. and title of clause | Content | | Clause No. | Content | Classification by clause | Detail of technical deviation | |
| 6 Verification procedures | 6.2 Outdoor Glare Rating limit | CIE S 015 | 6.2 | Approximately identical with JIS . | Alteration | The description is altered from "all assumptions shall be declared" to "it shall be confirmed that the lighting facility and its location, the surface finish of the space and the area are in accordance with the given conditions of calculation." | This alteration is for giving "all assumptions" concretely. This does not constitute any technical deviation. |
| | | ISO/CIE 8995-3 | 5.2 | Approximately identical with JIS . | Alteration | | |
| | 6.3 Obtrusive light | CIE S 015 | 6.4 | Approximately identical with JIS . | Alteration | With regard to verification, the description is altered from "shall be performed by the measurement" to "as required, it shall be checked that they do not exceed the values specified in table 3." | This does not constitute any technical deviation. |
| | | ISO/CIE 8995-3 | | No relevant clause. | Addition | Obtrusive light is added to ISO/CIE 8995-3 . | This does not constitute any technical deviation. |
| | 6.4 General colour rendering index | CIE S 015 | 6.3 | Approximately identical with JIS . | Alteration | The description is altered from "the lamps shall conform to the requirements" to "verification shall be by checking if R_a value satisfies the lighting design condition". | This does not constitute any technical deviation. |
| | | ISO/CIE 8995-3 | 5.3 | Approximately identical with JIS . | Alteration | | |

Overall degree of correspondence between **JIS** and International Standards (**CIE S 015**:2005, **ISO/CIE 8995-3**:2006): MOD

NOTE 1 Symbols in sub-columns of classification by clause in the comparison table indicate as follows:

- Deletion: Deletes the specification item(s) or content(s) of International Standard.
- Addition: Adds the specification item(s) or content(s) which are not included in International Standard.
- Alteration: Alters the specification content(s) which are included in International Standard.

NOTE 2 Symbol in column of overall degree of correspondence between **JIS** and International Standards in the comparison table indicates as follows:

- MOD: Modifies International Standards.

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